DANGER OF IMPORTING INSECT PESTS.

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INTRODUCTION.

It is only within very recent years that the agriculturists and horticulturists of this country have begun to realize thoroughly the fact that their crop interests are quite as seriously threatened by foreign insect pests as by native ones. The extensive work of extermination which the State of Massachusetts has been forced to undertake in an effort to repress or exterminate the gipsy moth has thoroughly opened the eyes of the New Englander; the advent of the Mexican cotton-boll weevil into Texas cotton fields has been a serious lesson to the planters of that part of the country, while horticulturists all through the principal fruit-growing portions of the country have learned the same disagreeable truth from the spread of the San Jose scale and the great damage which it has already done.

It is now some years since the writer began to look into this important subject, and he has already published several articles dealing with the general principles involved. In 1894 he started an investigation of the injurious insects of Mexico which are liable to be imported into the United States, and since that time has been collecting in one way or another information concerning the principal crop enemies in the countries having most intimate commercial relations with the United States, as well as specimens, in all stages, of the various insects themselves.

In the spring of the present year (1897) a convention was held in Washington, D. C., which was attended by representatives of horticultural and agricultural societies of many of the different States. This convention was called to consider the desirability of State and national legislation with a view to preventing the introduction and spread of injurious insects and fungus diseases; and while the bulk of its time was occupied by the question of interstate commerce in infested nursery stock and that of appropriate State legislation, much consideration was given to a proposed plan of national quarantine against pests coming from abroad. This fact is mentioned as indicating that at last the persons most interested understand the situation and are seeking for the remedy.

We need only look at the already long list of prominent injurious insects to become at once aware of the fact that had a national quarantine been established long ago its saving to the country would
have been enormous. For example, at the World's Columbian Exposition a somewhat elaborate collection of the injurious insects of the United States was exhibited by the Department of Agriculture. This exhibit was included under 602 numbers. Of these 602 numbers, 111 refer to imported species.

Again, the writer has drawn with great care a list of what may be termed the injurious insects of first-class importance. This list was prepared upon the most rigid lines, and every species not of prime importance was excluded. Seventy-three species remained, and these are insects whose names and depredations are familiar to almost every farmer and fruit grower. In fact, each of them almost annually causes a loss of hundreds of thousands of dollars. Of these 73 species, 30 are native to the United States, 37 species have undoubtedly been introduced from foreign countries, while 6 are of doubtful origin. Among the imported species it may be interesting to mention especially the codling moth, the Hessian fly, the asparagus beetles, the "buffalo moth," the hop plant-louse, the horn fly, the common cabbage worm, the sugar-cane borer, the wheat plant-louse, the pear midge, the oyster-shell bark-louse, the pea weevil, the croton bug, and the fly weevil or Angoumois grain moth, in addition to the three important species already mentioned. In many instances the original home of some of our worst insect pests which have been introduced from abroad can not be traced. They have become almost universally distributed, more or less independently of climatic changes, and may have reached our country from east, west, or south. To this class belong many of the most dangerous scale insects; in fact, we may say all of the most dangerous scale insects now occurring in this country. In 1889 the writer stated that the worst 23 scale insects then occurring in the United States were of foreign origin, and that number has unquestionably been considerably increased since that time. Most of the granary pests, most of the household pests, and most of the greenhouse pests also belong to this class.

EUROPE AS A SOURCE OF DANGER.

In glancing over the list of the principal introductions of this kind, it seems certain that the great majority of them have come to us from Europe or via Europe. This is natural enough, since the European climate is similar to our own and since trade connections with that part of the world are of very long standing and very frequent and the journey has of late years come to be of astonishingly short duration. A study of the animals and plants common to the two continents shows a great similarity between them, owing to a similarity in the natural conditions which exist and which govern the development and distribution of life. There is a greater similarity between the animals and plants of Europe and North America, or rather of North America and the more northern portion of the combined continents of
Europe and Asia, than between the forms of life existing in either area and any other of the principal life zones of the world or between any two others of these principal life zones; so that, entirely independent of the matter of trade connections, it would be safe to premise that injurious insects from Europe would be more likely to flourish in the United States and British North America than in other portions of the world, and that insects coming from other regions would be less likely to flourish in North America than would European forms.

Theoretically, and upon these considerations only, it would seem equally certain that injurious insects carried from the United States to Europe would flourish equally well, but this, curiously enough, is not the case, and the reason is difficult to find. Were we considering

![Image](image-url)

Fig. 25.—Euproctis chrysorrhoea: male moth above, female below, eggs at left, cocoon at right, larvae below at right—natural size (original).

injurious insects only, this unexpected condition might be explained largely from the widely differing crop conditions in Europe and America. The small size of the holdings, the closer methods of cultivation, the more frequent rotation of crops, in Europe, exercise a repressive influence upon injurious insects. Brought to this country, however, they are liberated from this repressive system, and being brought over also usually without their natural enemies, they are free to multiply and spread.

Our own species in turn introduced into Europe are likely to be destroyed by agricultural methods alone. This applies with especial force to the insect enemies of field crops. In lesser degree, but still to some extent, does it apply to the insects of the orchard. By no
means, however, can this state of nonreciprocity in pests be accounted for on these grounds alone. There are undoubtedly deeper influences at work, and upon this subject there has been much theorizing but no conclusions. It is a fact which must be generally accepted that the general trend of insect migration as well as of weed migration, as shown by Mr. L. H. Dewey in his important article published in the Yearbook of the Department for 1896, is and has always been from the East toward the West, and that the return migration is so insignificant as to be practically unworthy of consideration. It is true that coming from the East toward the West we move in the direction of the newer civilization, and this fact in itself has a greater significance than has generally been assigned to it.

By far the greater number of our principal injurious insects, therefore, have come to us from Europe. Of the species incidentally mentioned in a previous paragraph as prominent examples of introduced pests, all have come to us direct from Europe with the exception of three, viz, the sugar-cane borer, the cotton-boll weevil, and the San Jose scale. Of the European forms, it is likely that some of them originally entered Europe from Asia. We know, for example, that the codling moth exists in Siberia to-day, while the gipsy moth spreads across the temperate portions of Asia to Japan. The oyster-shell bark-louse has a similar distribution.

INJURIOUS INSECTS FROM THE TROPICS.

There are two or three points in the United States which have a distinctively tropical climate, and therefore contain tropical vegetation and tropical animals. These points are the coast of the tip of
Florida, the extreme southern tip of Texas along the Gulf of Mexico and the Rio Grande River, and the valley of the Colorado River in Arizona and southeastern California. Certain tropical insects show a tendency to spread into the life zone immediately north of the Tropics in low-lying regions, and, moreover, the central portion of Mexico between the eastern and western ranges of the Sierra Madre Mountains is in the main an elevated plateau, the climatic conditions of which resemble those of certain portions of our Western States; so that we have had injurious insects reach our Territories from the south, as well as from the east, and our increasing commercial relations, particularly with Mexico by reason of the new progressiveness of that country and the consequent activity in railroad building, will certainly, sooner or later, bring us other dangerous pests from that direction. Thus, the West Indian peach scale (*Diaspis lanatus = amygdali*) has been introduced into Georgia and other Southern States; the "red bug" or "cotton stainer" (*Dysdercus suturellus*), an insect which formerly did great damage to cotton in Florida and Georgia, probably came from the West Indies; the sweet-potato root-borer (*Cylas formicarius*) has thoroughly established itself within our boundaries, having been brought either from the northern countries of South America or from the West Indies; and the advent of the cotton-boll weevil into Texas, already referred to, is so recent and so serious an event as to indicate what Mexico may yet have in store for us.

**INSECTS FROM PACIFIC REGIONS.**

Although there is little similarity in general between the animals and plants of the so-called Oriental and Australian regions and those of our own country, we have already seen that certain species from these two regions, and particularly from the Australian, will successfully propagate in portions of the United States. It is true that the majority of these species have been scale insects, and we are beginning to find that the scale insects as a group are capable of almost universal spread. At all events, they are by no means as restricted in their possible distribution as are insects of other classes. The white scale
of California, an extremely destructive insect, which spread with astonishing rapidity over California during fifteen years, was Australian in its origin. The San Jose scale is probably of oriental origin. Even outside of scale insects we do not lack for examples of the possibility of acclimatization of injurious insects. The potato tuber moth (\textit{Lita solanella}) unquestionably came to California from New Zealand or Australia, and it has spread as far east as Colorado. Other species, with little doubt, would have followed its example had it not been for the admirable quarantine work carried on in California under the State board of horticulture. It is worthy of remark that our rapidly
increasing trade relations with western nations will continue to render this quarantine more important and more arduous.

Japan has evidently a number of injurious insects which have not yet reached us and against which we must be on our guard. In the recent impetus to scientific research, which Japan seems to have fostered, economic entomology has not been overlooked. As early as 1890 Professor Sasakii, of the Imperial University at Tokyo, studied with some care the habits of a peach-fruit worm allied to Grapholitha, and within the last two or three years Prof. M. Matsumura, of the agricultural college at Sapporo, has taken up the study of injurious insects with energy, and has corresponded with the writer about Japanese forms. A list of species already under observation by Professor Matsumura has been published (see Bulletin 4, technical series, Division of Entomology, "Some Mexican and Japanese injurious insects liable to be introduced into the United States," pp. 6 and 7). In a later paragraph is given some account of two prominent Japanese fruit worms.

INSECTS FROM OTHER PARTS OF THE WORLD.

From the far south it may be said, in general terms, that we have comparatively little to fear. In spite of the fact that there have been some successful establishments of injurious species, these are not likely to be many, particularly in our more northern States, and
this is due to the diametrically opposed seasons. An insect starting from Chile or Peru, for example, in the height of summer, would reach the United States in the dead of winter, under conditions, therefore, least likely to encourage its establishment and spread.

From the north there is little to fear, from the fact that we have already within our territory practically every species of injurious insect which occurs in British America. Should this Government, however, establish a general quarantine against foreign countries, and should Canada establish no such quarantine, there will always be the possibility of certain more northern forms reaching us via Canada and British Columbia.

**METHODS OF IMPORTATION OF INSECTS.**

Having shown what the probabilities are as to the countries from which new insect pests are still likely to come, the next point to consider is the principal means by which they reach our shores. As the writer has shown in a recent paper presented before the American Association for the Advancement of Science, these insect immigrants come mainly in three ways: First, they are unnoticed or ignored passengers on or in their natural food, such as nursery stock, plants, fresh or dried fruit, dried fruit stuffs, clothes, lumber, or domestic animals; second, their food may be the packing substances used to surround merchandise, or the wood from which cases are made; third, they may have been perfectly accidental passengers, having entered a vessel being loaded during the summer season and hidden themselves away in some crevice.

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**FIG. 33.—Different stages and method of work of *Rhinaria perdix*—slightly enlarged (redrawn from French).**
With insects brought over on plants or nursery stock the conditions could not well be much more favorable. Their supply of food is looked after with care, the host plant is soon put in the ground in the best of surroundings, and the greatest care is taken of this choice importation. Upon or in importations of this kind are carried scale insects in all stages of growth (and often, fortunately, their inclosed parasites), the eggs of plant lice, the larvae of wood-boring beetles, the eggs of many other insects, the cocoons of small Lepidoptera, and probably even in rare cases the larvae of Lepidoptera, since it now seems likely that the brown-tail moth (fig. 25) was imported into Massachusetts on nursery stock in its larval wintering nests. The scale insects, how-

![Figure 34](image)

**Fig. 34.** *Ceratitis capitata*: a, adult fly; b, head of same from fron.; c, spatula-like hair from face of male; d, antenna; e, larva; f, anal segment of same; g, head of same—a and e enlarged; b, g, and f greatly enlarged; c and d still more greatly enlarged (redrawn from Insect Life).

ever, are most abundantly carried in this way. Under natural conditions these insects have usually a rather restricted distribution, but by means of this commercial distribution many of them have become of almost world-wide range, and the end will certainly not be reached until every country possesses every species of scale insect which can possibly live in its climate.

Only second to the scale insects in the facility in which they are transported in this way are the plant lice. These insects, however, are fragile, soft-bodied, and unprotected. They are readily carried, nevertheless, in the winter egg condition, and many species are rapidly becoming cosmopolitan. For example, it was probably in this way that the hop plant-louse was originally brought from Europe to America and, within recent years, from the East to the far Northwest. Other still smaller and less studied insects are undoubtedly carried by
this method of transportation. Many of the thrips, for example, of North America have recently been discovered to be identical with those of Sweden and Russia. The small plant-feeding mites of the family Phytopidse are also particularly subject to this form of commercial distribution. Nearly all of the wood-boring beetles, common to Europe and the United States, have probably been brought over in nursery stock, and even the large wood-boring leopard moth, Zeuzera pyrina, probably came over in living plants. This commerce in nursery stock and living plants, is, moreover, rapidly increasing. The imports into the United States during the fiscal year ending June 30, 1896, reached the value of nearly $1,000,000, while the previous year they exceeded $600,000. This class of importations is, therefore, by far the most dangerous and affords the strongest argument for a system of inspection.

Upon imported fruits, fresh and dried, other dried food stuffs, cloths, lumber, and domestic animals many insects are brought in, but the opportunities for the establishment of such insects are by no means as great as are those of insects coming with nursery stock. As a matter of fact, moreover, the dried-fruit insects and those affecting domestic animals are in the main already cosmopolitan.

INSECTS IN PACKING FOR MERCHANDISE.

As to the second means of importation which we have mentioned, it is an undoubted fact that insects may be and doubtless are frequently transported in material used in packing merchandise. The well-known Hessian fly is supposed to have been brought over in straw bedding by the troop ships during the war of the Revolution and to have recently been carried from Europe to New Zealand in the straw packing of merchandise. Laws recently proposed in New Zealand, Australia, and Cape Colony provide that such straw or hay packing shall be burned immediately the case is opened. Other straw or grass inhabiting species have also been brought to this country in this way.
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The well-known wheat-stem sawfly borer of Europe (*Cephus pygmaeus*), which has been found in restricted numbers in portions of New York State, is an example, while all of the grass-stem maggots common to Europe and North America have also probably reached us by this method. Grains and grasses, in fact, all over the world, are subject to the attacks of a host of insects of all kinds, many of which pass the winter upon or within the stems, so that the proposed restrictions of the English colonies just mentioned are by no means unwise.

ACCIDENTAL IMPORTATIONS.

While the opportunity for the establishment of species brought over in the more accidental way mentioned in our third category are much less frequent than are the chances of species coming over attached to or contained in their normal food, still very many species which have flown into a vessel loading at a foreign port in the summer time are carried to us alive and are liberated with the unloading of the vessel on our wharves; and occasionally one of these is able through accidental conditions to establish itself and spread. Against such strictly accidental importations it will be practically impossible to defend ourselves, and it is fortunate that the opportunities for the establishment of such forms are so slight. It is very likely, however, that many of the two-winged flies common to Europe and North America have been brought over in this way and that certain other insects which in the summer are seeking places of hibernation, such as the clover-leaf weevil and the imported elm leaf-beetle, have been brought from Europe in this way.

![Fig. 37.—*Oscinis vastator* (redrawn from Curtis).](image1)

![Fig. 38.—*Chlorops tenuiopus*: larve and adult, and method of work—enlarged (redrawn from Curtis).](image2)
Insects Liable to Be Imported.

It would seem at first glance that it would be a simple and extremely desirable thing for the economic entomologist in this country to thoroughly familiarize himself with the prominent injurious insects of the countries having most frequent commercial relations with the United States, and especially with those species which from their habits would seem most likely to be brought into this country. Such knowledge having become general among consulting entomologists, the advent of any foreign insect would be at once recognized, and in the event of the establishment of an inspection system the labors of the inspectors would be rendered much more efficient.

All this is true up to a certain point, but experience has taught us two facts which modify this conclusion. The first is that many prominent injurious insects of foreign countries, living in such a manner as apparently to favor their easy commercial distribution and establishment are never carried abroad, or, if so carried, never succeed in establishing themselves; and the second is that many species unknown as crop enemies in their native homes, when once transported into a new country flourish to an astonishing degree and become pests of the first magnitude. So it is impossible to make a list of the injurious insects of foreign countries for the purpose indicated which shall have any great value.
Moreover, aside from the injurious insects of Europe, those of other countries have not been fully studied. There is at present considerable activity in the study of such species in the Australian colonies, in British India, and in Cape Colony, and within the last year or two in Japan, while of New Zealand the same may be said; but this interest is of very recent development, and useful knowledge is as yet slight. In other portions of the world almost nothing has been done. China, Mexico, South America, the settled portions of Africa, and other regions which might be also mentioned are practically unknown to the economic entomologist.

In spite of the difficulties pointed out, this paper would fail of its intent were not special mention made of some of the principal foreign insects which have not as yet succeeded in establishing themselves within our territory. An extended catalogue of such species would be impossible for the reasons mentioned, and for a popular paper we may mention with some little detail as to habit only a very few of the more injurious and striking forms. The illustrations which are scattered through this paper show some prominent insects of this kind.

At the convention of horticulturists held in Washington, D. C., in March, 1897, already mentioned, the delegates from California insisted upon the necessity of quarantine against foreign countries. While the State of California has long been alive to this question herself, supporting a quarantine system which has been very effective as against insects occurring upon importations consigned to persons living within the State of California, she has not been able to protect the country at large, except measurably, even from insects entering at the port of San Francisco; but in supporting the idea of national legislation against foreign pests, these delegates had particularly in

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![Image of insects and webs](image-url)
mind the danger of the introduction of the Morelos orange fruit worm from Mexico, and the imminence of the danger of such introduction was the immediate cause of their attendance at the convention.

THE MORELOS ORANGE FRUIT WORM.

For a number of years it has been known that Mexican oranges sold in the New Orleans market occasionally contained maggots. The writer ascertained this when visiting New Orleans as long ago as 1881, but was unable to secure specimens. In 1887 Prof. Lawrence Bruner, then an agent of the Division of Entomology, while visiting Mexico, secured infested fruit, took it home with him to West Point, Nebr., and succeeded in rearing the adult insect, which proved to be a two-winged fly, described in 1873 from Mexico by Loew, the Austrian naturalist, as *Trypeta ludens* (figs. 26 and 27). According to Bruner's report, this insect was most abundant in the oranges raised in the State of Morelos, 100 miles south of the City of Mexico, and the statement was made to him while in the City of Mexico that oranges from Morelos were very liable to be thus infested. An article upon the insect was published by Riley in the first volume of Insect Life (July, 1888), but no further information as to the natural distribution of the species was gained for a number of years. In late December, 1894, and again in February, 1895, the orange groves of Florida suffered, as will be remembered, to a very serious extent from severe cold. Hundreds of thousands of trees were killed and the orange crop for that year was practically annihilated. It resulted that during January, February, and March, 1895, and again during December, 1895, and January, 1896, orange buyers spread out into the West India Islands, and many of them went to Mexico. The shipments of Mexican oranges into the United States took an enormous jump, and the markets of our Northern and Eastern States were largely supplied with this fruit. Many persons saw the Morelos orange fruit worm in oranges upon their tables for the first time during these winters, and many newspapers contained accounts of the supposedly new insect.

![Image of Morelos orange fruit worm](https://example.com/image.jpg)
In only one case, however, so far as we know, was an effort made to trace the exact source of the infested fruit. Prof. W. G. Johnson, now of the Maryland Agricultural Experiment Station, but then assisting Prof. S. A. Forbes, at Champaign, Ill., found the worms in his own breakfast oranges, traced the stock to a particular dealer in Chicago, and from him learned that the consignment of which these oranges were a part came from just south of the City of Mexico—presumably the State of Morelos.

For some years past the Mexican oranges have reached the California market in the early fall, before the California fruit has ripened. Shipments have been begun as early as October and have continued up to December, when the California fruit is fit for consumption. The occurrence of these Morelos maggots in some of this fruit was pointed out in certain of the California papers during the fall of 1896, with the result which has already been indicated.

The shipment of this Mexican fruit through to the Northern United States can do no possible harm, since this species, so far as known, breeds only in citrus fruits. Even did it attack other fruits, such as peaches, pears, and apples, as some of its close allies are known to do, the fact that the oranges are shipped in winter would bar its introduction. During the seasons following the Florida freezes this fruit was even carried into Florida and was found upon the tables at the principal winter resorts in that State. So little native fruit was left in the State, however, that even this could not be considered as very dangerous. The carriage of infested fruit into the State of California, however, is quite another matter. It arrives there just before the California fruit begins to ripen. A Mexican orange containing these maggots thrown away even at some distance from an orange orchard might result, as can readily be seen, in the establishment of this destructive species in California. There is little wonder, then, at the interest felt in the matter by fruit growers in that State.

In 1894, as we have already stated, an agent of the Division of Entomology was sent to Mexico for the purpose of investigating the insects injurious to agriculture. This agent, Prof. C. H. T. Townsend, reported incidentally upon this insect, although his trip was made before the "scare," if we may call it so, had developed. He showed that oranges were shipped from Guaymas and Hermosillo, in Sonora. Sonora oranges were sent to Chicago and other eastern points, some going, however, to California to the San Francisco market. The Morelos oranges, according to the information which he was able to gain, were shipped only as far as the City of Mexico. This, however, we have already shown was a mistake. From the Guadalajara region oranges were shipped by the car load through to northern points, mainly to Kansas City. The same was the case with the oranges of Tamaulipas. He could find no evidence that *Trypeta ludens* infested any oranges except those from the State of Morelos.
During the winter of 1895-96, however, it was learned from American orange buyers that the Morelos fruit worm existed also in the State of Puebla.

During his travels in the summer and fall of 1897 in Mexico, Mr. Albert Koebele was good enough to further investigate this question of the distribution of this insect. He was informed by the agent of the Wells, Fargo Company, at the City of Mexico, in October, 1897, that but few oranges are now shipped by this company. A few years since, however, large quantities from the State of Morelos were delivered to their office by the Interocceanic Railroad, to be shipped to the United States via El Paso, their ultimate destination being unknown to the agent. The freight agent of the National Railroad informed him that but few oranges were shipped from the State of Morelos; many, however, were shipped from the States further north, principally for New Orleans and Central States.

The agent of the Interocceanic Railroad informed him that some of the fruit was shipped by his railroad, chiefly from Jalapa, and thence to Vera Cruz, and no doubt from that place by steamer to New Orleans and other points. It was by this road that, in Mr. Koebele's opinion, the largest quantity of the Morelos oranges were exported, since their line runs through the States of Morelos and Puebla. This agent stated that about 100 car loads are shipped annually from Jalisco. He was informed by the agent of the Mexican Central Railroad that but few oranges were shipped from the City of Mexico, though a great many were shipped from further north, and especially from the Guadalajara branch, chiefly to St. Louis and Chicago. An experienced fruit merchant informed him that he had found the larva in Morelos oranges and also in considerable number in those from Michoacan, Puebla, and Jalisco. The same merchant also informed him that the National Railroad buys large lots of oranges in the City of Mexico for shipment.

This represents our actual knowledge of the distribution of the species in Mexico down to the autumn of 1897. Appreciating the desirability from every point of view of exact information on this important question, Professor Townsend was commissioned to visit in November and December, 1897, every orange-growing district of Mexico, with the exception of Sonora, and to examine into conditions with relation to this one insect. He carried out his mission with success, and found, as anticipated by the writer, that the orange fruit worm occurs practically wherever oranges are grown to any extent in Mexico. Good evidence was gathered of the existence of the species in the following localities: Morelos, Cordova, Yantepec, Coatepec, Teoselo, Amacusac, Puente de Ixtla, Toliman, Jalapa, San Luis Potosi, Pueblo Nuevo, Cuernavaca, Monterey, Linares, Montemorelos, Chihuahua, Guadalajara, Escalon, San Cristobal, Ameca, La Barca, Victoria, Tuxpan, Jalisco, Manzanillo, Acapulco, and Guerrero. The fruit flies have actually been reared in Washington, D. C., from
oranges received from Professor Townsend from the City of Mexico, from Cordova, from Jalapa, and from Tampico. There is, however, no certainty as to where the Tampico oranges were grown.

Mexican orange growers have become much interested in the subject of the California opposition to their fruit, and are naturally, though not justifiably, indignant at the California call for quarantine or prohibition of their fruit. One of the leading industrial papers of Mexico, El Progreso, contained a leading article last spring insisting that the true cause of the California movement was "the desire which these horticulturists have of freeing themselves from the competition which grows more threatening for them day by day, and not that of escaping from the problematic infestation."

The knowledge of the exact details of the life history of *Trypetia ludens* may prove of value in this apparent emergency. Unfortunately, the insect has not been carefully studied in its native home by a competent entomologist. Bruner brought back with him in the early winter specimens of oranges containing larvae, and from these bred the adult fly the following February. All of the oranges showed a more or less well-defined outward sign of the depredations of some insect enemy. In one a freshly made hole coming to the surface was found, and one of the maggots was observed protruding. December 30 several of the larvae had pupated, having left the fruit December 22. The fruit itself had rotted and molded, and about one-half of the pulp had been devoured. The first adult appeared February 9. The adults of both sexes were confined with ripe fruit to see if they would oviposit in the orange, if not on the tree. Experiments failed, however, and none of the flies laid eggs, all dying after several days. Johnson experimented with two infested oranges. In both instances the fruit was perfect, so far as outward appearances were concerned. There were no visible ruptures or punctures in the skin, and the flavor of the fruit was sweet and luscious. The maggots when first noticed, on January 10, were about one-third of an inch long, of a dirty whitish color, and worked their way freely through the pulp. The fruit was placed in a dish with some larvae, and after three or four days became very moldy; but the larvae continued feeding until January 18, when two of them, having reached the length of 11 mm., left the oranges and burrowed into the ground, one pupating on the 21st and the other on the 24th. The first adult, a male, issued February 28, or just thirty-eight days after pupation. Four days later the second fly emerged.

The observations of both Messrs. Johnson and Bruner show that the fly is hardy and will stand considerable neglect. Mr. Johnson kept a male and female for several days in close confinement in a glass-covered dish and they were seemingly as active as ever when removed. Mr. Bruner showed that the flies can stand a considerable variation in temperature, since on several occasions during his
experiments the mercury fell below the freezing point in the room where his breeding cage stood.

The oranges received at Washington from Professor Townsend from the City of Mexico, Cordova, Jalapa, and Tampico all arrived between November 26 and December 21, 1897. The first flies were reared January 12, 1898, and between that date and February 3 twenty-five active specimens emerged, of which fifteen were females.

The different stages of the insect, with the exception of the egg, are well indicated by fig. 27. The larva is dirty white, the puparium is light brown, and the adult fly is straw yellow in its general color. The bristles upon its body are black and the stripes upon the body are silver yellow. The markings upon the wings, as shown by the figure, are brownish yellow with brown edges.

OTHER FRUIT INSECTS IN MEXICO.

There are other insects which attack the fruit of citrus plants in Mexico of which we know much less than we do about the Morelos orange worm. A broad, stout maggot, which may belong to the same family as this worm, is found in oranges in the States of Michoacan and Jalisco, and in the same States a little caterpillar of the family Tortricidae works in the skin of the fruit. Insects of the same genus as Trypeta ludens are also found in Mexico, and the larva of one of these has the injurious habit of working in peaches in much the same way as T. ludens does in oranges and as the so-called "railroad worm," or apple maggot (Trypeta pomonella), works in apples in the northeastern United States. This species has been reared by Mr. Koebele from peaches at Orizaba and is Trypeta acidusa Walk. It is shown by fig. 28.

INJURIOUS AUSTRALIAN INSECTS.

From a study of the recent Australian reports and from correspondence with certain of the newly appointed colonial entomologists, it appears that there are several very destructive insects in Australia which are entirely unlike anything occurring in the United States, and which may at the same time be imported, and if imported might prove disastrous to certain fruit-growing industries. These are the apple root-borer (Leptops hopei), the apple fruit beetle (Doticus pestilens), the harlequin fruit bug (Dindymus versicolor), and the cherry borer (Maroga gigantella).

The apple root-borer (fig. 29) belongs to a genus which is indigenous to Australia, forty-four species having been found in the various colonies. For the past thirty years the species in question has been known in Victoria to attack fruit trees, especially apples and pears, but it has only recently become a serious scourge. In one case 13 acres of fine trees, most of which had been in full bearing, were rooted up and destroyed, owing to the damage done by this insect. The affected
trees died from the top branches downward, and upon examination the larger roots, mainly 8 inches or more below the surface, were found to have been tunneled by the larvæ of Leptops, as shown by fig. 29. The figure of the larva and its work has been adapted from Mr. Charles French’s “Handbook of destructive insects of Victoria,” and that of the beetle from Kirby.

The apple beetle attacks the fruit of the apple and bids fair in portions of Australia to rival the codling moth in its damage. Its capacity for damage is, in a way, greater than that of the codling moth, since the latter insect, while frequently spoiling fruit for table purposes, does not damage it for cider. Indeed, as Walsh once said, it is problematical whether the presence of thousands of codling-moth larvæ in cider apples does not improve the quality of the cider. The work of the Doticus, however, results in the complete shriveling of the apple, rendering it unfit for any purpose whatever, as indicated by fig. 30. The beetle is a minute species, brown in color, perhaps one-sixth of an inch in length, and of the general appearance shown by fig. 30. Mr. French considers that this insect was probably imported from West Australia into Victoria, either from Queensland or some of the Polynesian group of islands. The exact period at which the eggs of the insect were deposited is not known, and little is known, in fact, about the other points in the natural history of the species. Apples containing the grub wither and dry up, and the shriveled fruit frequently hangs upon the tree for a whole year. The fact that the fruit does not at once begin to wither allows an opportunity for the exportation of the insect within apples, and renders the spread of the species possible. The Australian apples received at the port of San Francisco have frequently been found by Mr. Craw, of the California board of horticulture, to contain shriveled fruit, resembling that in which the Doticus has been working; but up to the present time no evidence has been found of the incoming of the living insect.

The harlequin fruit bug (Dindymus versicolor) is a small red and black bug, illustrated by fig. 31, which is found only in the Australian colonies. The eggs are laid during the late summer months, among rubbish, under logs, stones, decayed wood, and stubble. The young insects, which have an odor, by the way, like bedbugs, and crawl actively around, sucking the juices of growing plants, upon attaining wings fly into the trees, and have been the cause of much damage to the apple crop. They insert their beaks into the side of the ripening apples, extracting the juice and causing the apples to become spotty.

The cherry borer (Maroga gigantella) is the larva of the moth shown by fig. 32. These larvæ, which are pinkish white in color, destroy cherry trees, plums, apricots, nectarines, and even quinces, by boring at first under the bark and then into the heart of the tree. The sawdust-like excretion on the trees is a sufficient indication of
the presence of this larva. As early as 1860, this insect was reported by the late Henry Edwards to have destroyed nearly all of the cherry trees in a large garden at Richmond, Victoria. This insect, according to Mr. Edwards, was originally a borer in the black wattle (Acacia decurrens), and has evidently transferred its attentions from this tree to fruit trees. Curiously enough, although boring in wood like the larva of the moth family Cossidae, this insect is a Tortricid, the majority of the species of which are leaf rollers.

The strawberry beetle (Rhinaria perdirx), shown at fig. 33, is another of the Australian species. It is reported to be a very serious enemy of the strawberry grower, and in some cases of the grower of raspberries, in Victoria. They destroy both the flower and leaf stalks by tunneling, and the larvae eat large holes in the crown of the plant, killing it outright. The beetles are most plentiful in December, and are found until the early part of February.

THE BERMUDA PEACH MAGGOT.

Before referring to European pests of importance which have not yet reached us, attention must once more be called to the occurrence in neighboring West India islands of a fruit insect of great importance. We refer to the peach maggot of Bermuda (Ceratitis capitata). This insect (fig. 34) has already a very wide distribution, and this not only in peaches, but also in oranges and other fruit. It occurs in the East Indies, in South Africa, in Mediterranean countries, as well as in Bermuda, and it is a wonder that it has not already established itself in this country. In Bermuda, some years ago, the peach crop was almost annually completely destroyed by this insect, and this has practically been the case since 1866. Many peach trees have been cut down owing to its damage.

A FEW EUROPEAN DESTRUCTIVE INSECTS.

It would be interesting to mention the habits of a number of liable importations from Europe, but there is space for only a few.

One of the insects most abundantly treated in European works on destructive insects is the celery, or parsnip, fly (Tephritis onoperdinis). The celery crop suffers more severely from the attacks of this insect than does the parsnip. The eggs are laid on or in the leaf, and from these hatch maggots which feed between the upper and the under surface of the leaf, causing large blister-like patches. Where the insect is abundant, the leaves are destroyed and the plants are consequently greatly damaged. When full-grown, the maggots generally leave the leaf and transform beneath the surface of the ground. There are several broods, and development is rapid. This species is shown at fig. 35.

There are already two important clover enemies in the shape of
DANGER OF IMPORTING INSECT PESTS.

beetles imported from Europe, viz, the clover root-borer (*Hylesinus trifolii*) and the clover-leaf weevil (*Phyllonomeus punctatus*). There are several other European beetles, however, which in their native home are even more destructive than these species, and which, it is rather surprising, have not yet been reported. Prominent among these is one of the pear-shaped weevils, known as *Apion apricans* (fig. 36). They are common upon red and purple clover, laying their eggs in the blossom heads. The larvae feed on the still unripe seeds and seriously injure the production of clover seed. The heads wither rapidly, and when the larvae are full grown they turn to pupæ at the bottom of the flower, the weevils issuing in about a fortnight. There are several broods each year. The harvested clover retains the insects, and swarms of weevils issue from it.

In Europe no insect is more prominent as an enemy to small grains than *Oscinis fril*, the "frit fly," as it is called in England. Already the Hessian fly and the wheat midge from Europe have established themselves in this country, and it is astonishing that not only *Oscinis fril*, but several other allied species, such as the gout fly or ribbon-footed corn fly (*Chlorops laniopus*), have not also been brought over in hay or straw packing. The frit fly is especially abundant and injurious in northern Europe. Its maggot works in the stems and leaves of the young growing plant, and has also been recorded as feeding in its second generation on the soft grains in the ears of barley, thereby causing the light, worthless development of the grain known in Swedish as "frits"—hence the name of the fly. A nearly related European species, *Oscinis vastator*, is illustrated by fig. 37. The ribbon-footed corn fly (fig. 38) affects wheat, rye, and barley, but is most prevalent on barley. The work of its larvae produces a swollen state of the heads of the grain, the ear being unable to burst its sheaths. The eggs are laid in the forming ear while still wrapped in the sheathing leaves, and the larva forms a tunnel down one side of the stem to the uppermost knot, where it changes to a puparium.

A well-known wheat enemy in Europe, known in England as the corn sawfly, *Cephus pygmaeus* (fig. 39), has already reached this country, although, contrary to what might be expected, it has attracted no attention by its injuries. It has been found at Ithaca and Buffalo, N. Y., and near Ottawa, Canada, as well as in Manitoba. It was first captured in this country near Ithaca, certainly as early as 1882. The female lays her eggs one at a time in the wheat stem, just below one of the knots. The larva feeds on the soft inner substance of the stalk, and about harvest time, or a little before, reaches the base of the stem, where it gnaws a ring so nearly through that the straw readily falls with its own weight or from a slight wind. From the drain on the vitality of the stalk, the ear seldom produces the usual number of seed or full seed, and frequently appears white when the remainder of the field is green. This is an insect which
is constantly liable to be reintroduced should previous introductions die out from one cause or another.

The commonest of our currant worms, the larva of a sawfly, *Ne-matus ventricosus*, is an importation from Europe, but the commonest of the European currant worms has not yet reached us. It is the larva of the so-called magpie moth, *Abraxas grossulariata* (fig. 40), and is a variable species, one of the common forms of which we have illustrated. The caterpillar feeds on both gooseberry and currant, is widely distributed in Europe, and is one of the commonest of the English species. The caterpillar is one of the loopers, and makes its appearance in August or September. It passes the winter in the caterpillar stage, among the leaves and rubbish at the surface of the ground, coming out again in the early spring and feeding upon the new foliage, doing its principal damage at this time.

One of the most serious enemies of apple trees in parts of Europe is the small ermine, *Hyponeutea padellus* (fig. 41). This insect, which is mentioned in almost every work upon European economic entomology, is a small white moth, with black spots on its forewings, which lays its eggs in roundish bunches on small twigs, covering them with a gummy substance, yellow at first, but gradually changing to a dark brown, so as not to be easily distinguished from the brown twigs. The eggs hatch about the end of October in England, but the caterpillars remain sheltered by the gum until spring, when the leaves begin to unfold. They burrow into the young leaves and at first feed upon the parenchyma, afterwards destroying the whole leaf, feeding in companies and spinning webs, as shown in the figure. The moths appear about the end of June.

**SOME DANGEROUS JAPANESE INSECTS.**

Of Japanese insects we need mention at this time only two species. These are the apple fruit borer (*Laverna herellera* Dup.) and the pear fruit borer (*Nephoteryx rubrizonella* Rag.). Accounts of each have been sent us by Prof. M. Matsumura, of the agricultural college at Sapporo. The figures which we introduce of these two insects are redrawn from Professor Matsumura’s sketches.

The apple fruit borer (fig. 42) is said to be the most troublesome insect with which the fruit growers of Japan have to contend. It is thought to have been introduced into the country, and is now met with there wherever apples are grown. The larv^ live only in the core of the apple, injuring the seeds. They mature in about a month, make a passage through the flesh of the fruit, crawl or drop to the ground or emerge from the fallen fruit, making white cocoons in the earth and hibernating in the pupa stage. It produces only one brood each season.

On the day that these words were written, November 11, 1897, parts of two apples were received from Mr. Craw, at San Francisco, which
a passenger on the steamer from Japan had given him, and which showed evidence of the work of what is very probably this insect. No specimens of the insect itself were found, but the apples contained the larval burrows leading to the core, and two of the seeds had been eaten out. It is not likely that the passenger would have bought damaged apples in Japan, and, therefore, it is probable that the larvae issued from the fruit on the journey; so that it appears to us that this insect is one which is particularly liable to be introduced. It has since been learned that this insect has already probably gained a foothold in British Columbia.

The pear fruit borer (fig. 43) is the larger of two species of similar habits found in Japan. Professor Matsumura states that pear growers lose every year from 30 to 50 per cent of their crops from this insect, which is more troublesome than the apple fruit borer. The eggs are laid under a small twig, in clusters of twenty, protected by a white silken web. They hatch early in June, at the time when the fruit has reached the size of a cherry. The young larvae spin a considerable amount of silken thread on the twigs and make their way to different fruits near by, which they puncture to the core, always leaving a blackish opening at their entrance. Their presence is readily detected by these holes. The larval stage lasts three weeks or more, and the pupal change is undergone within thin silken cocoons inside the fruit. The insect hibernates in the egg stage.

NATIONAL QUARANTINE AND INSPECTION.

It would be a comparatively simple matter to go on indefinitely with these brief accounts of foreign insects, but for reasons already pointed out this is not considered necessary. It has been shown that the majority of our most injurious insects have been imported. It has also been shown that not only are there many other injurious insects in foreign countries which are noted enemies of cultivated crops, and which are constantly liable to be brought over under our present lack of inspection, but also that species of foreign countries not known as especially injurious are liable to multiply excessively and to become serious pests when brought into this country.

The remedy for this condition of affairs is obvious. Laws must be passed establishing a system of inspection of dangerous classes of merchandise, just as has already been done in the case of live stock, and just as has already been done in a partial way by the State of California.

The experience in California is an interesting one and its results should be appreciated. By the operations of a State law and by the cooperation of the common carriers of the State, an inspection system has been carried on for a number of years, which, without doubt, has prevented the establishment of many species of injurious insects within the State boundaries. Every vessel containing suspected
articles entering at the port of San Francisco is examined by the State officer, who has power to condemn or to order treated all plants, trees, nursery stock, or fruit consigned to persons living in California, which, in his judgment, may need such condemnation or treatment. This system of inspection at the port of San Francisco, however, does not protect the country as a whole, except indirectly, since articles consigned to persons living outside of the State are beyond the jurisdiction of the State officials. The protection of a national law is, therefore, needed, even at San Francisco. The passage of some such national measure as that recommended by the convention of horticulturists and agriculturists held in Washington, D. C., March 5, would seem, from a consideration of the facts here presented, to be abundantly justified by the constant danger which threatens our agricultural and horticultural interests.